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(54) A shoplifting detection system, in particular suitable for use in supermarkets, and a shop design comprising such a shoplifting detection system.

(57) A shoplifting detection system, in particular suitable for use in shops designed as supermarkets, which detection system is designed to generate in a plurality of passageways separated from each other by obstacles a magnetic detection field by means of suitable transmitting antennas so as to enable by means of suitable receiving antennas detection of a responder located in the detection field and disturbing the detection field, transmitting and receiving units being provided which are connected with the transmitting and receiving antennas, wherein on both sides of each obstacle placed between two passageways antennas of the same type are provided while the type of antenna of two juxtaposed obstacles separated by a passageway is always different.

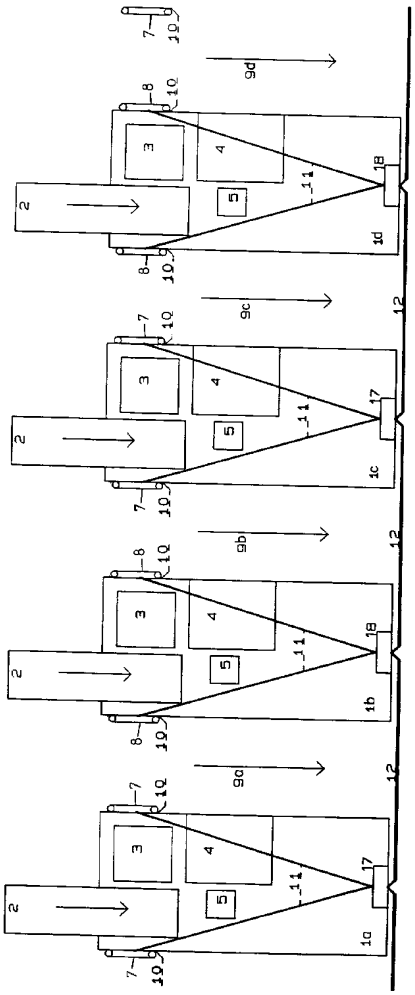

FIG.2

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The invention relates to a high-frequency type shoplifting detection system. In the prior art shoplifting detection systems a transmitting coil ("transmitting antenna pillar") generates a magnetic alternating field having a varying frequency. This frequency generally lies within the range of from 1 to 10 MHz.

Attached to the goods to be secured are so-called detection labels. These labels, also called wafers, contain a resonance circuit consisting of a coil tuned with a capacitor. They can be designed, e.g., as a flat plastic box containing an air-core coil or as an adhesive label built up with a flat printed coil and a foil capacitor or as a circuit having divided capacity and self-induction or in some other way.

When such a label is brought into the magnetic alternating field of the transmitting coil, at the moments the frequency of the alternating field equals the resonance frequency of the resonance circuit in the detection label, that circuit will absorb energy and co-resonate. This co-resonating causes a field disturbance which can be detected by a receiver circuit which is either connected with the transmitting antenna in a so-called absorption system or coupled with a second (receiving) antenna in a so-called transmission system. These shoplifting detection systems are known, inter alia from applicants' Dutch patent applications 82 02951 and 89 00658. Such detectable field disturbances can be generated by means of magnetic responders, e.g. as described in US patent 4 118 693.

The transmitting/receiving antennas of a complete shoplifting detection system are realized, e.g., in a row of upright or self-supporting antenna coil structures, also called pillars. The transmitting and/or receiving electronics are mostly located somewhere in the pillar, preferably in the foot. These pillars have hitherto been used especially in shops, such as clothes shops, in which the row of pillars is placed just in front of the exit. In such surroundings the pillars are mounted directly to the floor, the direct surroundings of each pillar being free of obstacles. The pillars provided with transmitting antennas generate on both sides a magnetic alternating field. Similarly, the pillars provided with receiving antennas have a sensitivity range extending on both sides of the pillar. In order to make it possible upon detection of a label to find out in the best possible manner who has the detected label on him, a visual signalling device is desirable for each passageway. In a transmission system a label can pass to the left or right of a receiver pillar. The label signal in the receiver is identical in both cases. It makes no difference whether the label is irradiated by the left or by the right transmitter. In order yet to make it possible to distinguish between the left or right passage of a receiver pillar, the two transmitters to the left and right of this pillar, i.e. the even and odd numbered transmitters in the row, are alternately switched on and off: multiplexed.

From the phase of the multiplex signal at the moment of detection of a label, i.e. the signal alternately switching on the even and odd transmitters, it is derived in the receiver whether the label is to the left or right of the antenna. With this information the signalling device belonging to the passageway is controlled. Multiplexing has to take place at a frequency high enough not to adversely affect the reaction velocity of the system. In practice, the lower limit is 2 Hz and the upper limit the half sweep frequency (multiplexes per complete sweep period).

Another use of high-frequency type shoplifting detection systems relates to the use in shops designed as supermarkets, in which payment for the goods bought takes place at so-called cash blocks. Cash blocks are mostly constructed by means of metal beams, metal or wooden faces provided with a conveyor belt, a (computer) cash register and sometimes a bar code scanner and/or a pair of scales. In such a cash block a cashier is sitting. The customers will pass in front of the block and put the goods to be paid for on the beginning of the conveyor belt. The belt conveys the goods to the cashier who feeds them into the cash register, optionally with the aid of the bar code scanner, after which payment takes place. In the meantime, the goods have moved further to a place on the cash block behind the cashier, in the direction of the exit of the supermarket. Consequently, a separation takes place between the stream of goods to be paid for and the associated customers. In a typical supermarket situation a series of these cash bloks is lined up in a row. The customers pass between the cash blocks in the direction of the exit. A medium-sized supermarket easily contains more than ten cash blocks. This arrangement is also designated by the term "check-out system". In order to check whether customers passing the cash block take along goods not placed on the belt and therefore not paid for, detection fields are generated in the gangways between the cash blocks. This may be done, e.g., by means of two pillars: a first pillar comprising receiver electronics and a second pillar comprising transmitter electronics. A detection system in this use is preferably built with shielded antennas.

By using antennas shielded on the back with a shield, undesirable electromagnetic coupling between receiving and transmitting antennas and the electric conductors in, on or at the cash block is prevented. Multipad propagation effects and parasitic resonances in constructional parts and cabling in the cash blocks could otherwise give rise to a decreased detection sensitivity and false alarms.

Such shielded antennas are described, e.g., in applicants' international patent application WO 91/17533. These antennas also have the advantage that no label detection takes place on the back where goods the labels of which have not yet been deactivated pass on the conveyor belt so that no undesirable alarm can be caused. Only at the front of the an-

tenna, in the area where the customers pass, is a magnetic alternating field generated. Because in this configuration each gangway has a separate detection system of its own, the associated receiver can only receive in this configuration a label signal generated by the field of the associated transmitter. The detection of labels is therefore inherently selective for each passageway, and multiplexing is not necessary.

Now a situation has arisen with alternate passage - non-passage (blocking) in which the customers pass through the passageway and the cash blocks form the non-passage or blocking. In the non-passage detection of labels is undesirable.

It has been found that the effect of the shield in a shielded pillar is not perfect. There is always left, through the shield, a remaining coupling of the detection field with conductors present in the cash blocks.

A further drawback of the prior art detection system is that for each cash block separate electronic units are necessary to activate the different antennas of the detection system, which makes the prior art device relatively complicated and expensive.

The object of the invention is to remove the above drawbacks and generally to provide an improved, efficient and reliably operating shoplifting detection system which is particularly suitable for use in shops designed as supermarkets.

According to the invention a shoplifting detection system, in particular suitable for use in shops designed as supermarkets, which detection system is designed to generate in a plurality of passageways separated from each other by obstacles a magnetic detection field by means of suitable transmitting antennas so as to enable by means of suitable receiving antennas detection of a responder located in the detection field and disturbing the detection field, transmitting and receiving units being provided which are connected with the transmitting and receiving antennas, characterized in that on both sides of each obstacle placed between two passageways antennas of the same type are provided and that the type of antenna of two juxtaposed obstacles separated by a passageway is always different.

In the following paragraphs the invention will be described in more detail with reference to the accompanying drawings. In these drawings:

Fig. 1 is a diagrammatic top plan view of a check-out system of a supermarket provided with a shoplifting detection system according to the prior art;

Fig. 2 is a diagrammatic top plan view of an example of a first embodiment of a check-out system provided with a shoplifting detection system according to the invention;

Fig. 3 is a diagrammatic representation of an example of a further elaboration of the inventive concept; and

Fig. 4 is a diagrammatic representation of another example of a further elaboration on the inventive concept.

Fig. 1 is a diagrammatic representation of an example of a check-out system as often used in shops designed as supermarkets, e.g. food shops. The check-out system shown comprises a plurality of juxtaposed cash blocks 1a through 1d. Located between each pair of juxtaposed cash blocks is a gangway 9a through 9d, via which the customers can go to the exit, after having paid for the selected goods at the cash desk. The cash blocks may be constructed in different ways. In the example shown the cash blocks comprise a conveyor belt 2, a (computer) cash register, a bar code scanner and/or a pair of scales 5 and a seat 4 for the cash personnel. In operation, there is generated in the gangway between two cash blocks a detection field capable of detecting electronic or magnetic responders attached to the shop goods when the shop goods are conveyed through the gangway instead of via the conveyor belt past the cash personnel.

In the example shown the detection field is generated by means of antennas 6 arranged on both sides of each gangway. The antennas are mostly accommodated in an antenna pillar disposed against a cash block or (partly) put into a recess in a cash block. The antennas are preferably shielded from the associated cash block. The figure shows on both sides of each cash block a receiving antenna 7 and a transmitting antenna 8. In the foot of the antenna pillar or in the cash block there are further disposed a transmitting unit and a receiving unit connected with respectively the receiving antenna and the transmitting antenna.

As a result of this configuration there are also disposed on both sides of each gangway a transmitting antenna 8 and a receiving antenna 7 as shown in Fig. 1. Since each receiving antenna is connected with a separate associated receiver not connected with other receiving antennas, it is always certain upon detection of a label in which passageway detection took place.

Some sensitivity to false alarm, however, may continue to exist, even when shielded antennas are used as described in WO 91/17533.

According to the invention the sensitivity of a check-out system to the remaining undesirable effects of a multipad propagation caused by, inter alia, coupling of transmitters, via conductors and apparatuses, with receivers on the other side of a cash block, and by parasitic resonances of conductors in the cash blocks can be further reduced. To this end, according to the invention the same pillar type is mounted on both sides of a cash block: alternately, therefore, two transmitterg pillars or two receiver pillars for each cash desk. The detection range and the sensitivity to undesirable coupling via the cash block between two pillars of the same type are much lower

than between a transmitterg and a receiver pillar. Consequently, labelled goods on the conveyor belt of the cash block give less cause to false alarm.

An example of a check-out system thus designed is diagrammatically shown in Fig. 2. Cash block 1a is provided on both sides with receiving antennas, cash block 1b with transmitting antennas etc.

According to the present state of the art, each antenna in a check-out system is connected with the transmitter or receiver electronics belonging to that antenna, which electronics may or may not be mounted in the antenna pillar.

It is also possible to connect the shielded antennas with a coaxial cable 11 to the associated receiving or transmitting unit 17 or 18, which is then accommodated in a separate box outside the pillars as also shown in Fig. 2. When a check-out system is thus constructed with alternately two transmitting or two receiving antennas for each cash block, a cash block therefore contains alternately two transmitter and receiver electronics units.

According to a further elaboration on the inventive concept a strong simplification may be realized by arranging instead of two electronics units of the transmitter or receiver type for each cash block only one electronics unit which is connected to the two antennas on both sides of the cash block. The electronics units may be connected via cables 12. Such a configuration is diagrammatically shown in Fig. 2. Cash blocks 1a and 1c are each provided with a receiving unit connected via coaxial cables 11 with the receiving antennas 7, and cash blocks 1b and 1d are each provided with a transmitting unit 18 connected via coaxial cables 11 with the two transmitting antennas 8 of each cash block. Practical examples are diagrammatically shown in Fig. 3 and Fig. 4.

In the simplest embodiment (schematic diagram in Fig. 3) the two antennas 6 with the shielding 10 of a cash block 1 are parallel connected to the corresponding electronics unit 17 or 18, e.g. via a coupling transformer, a power splitter/combiner 13 or a directional coupling. By multiplexing the transmitting units 18a, 18b, i.e. alternately switching them on by means of suitable control means 20, according to the principle described for a detached row of pillars, simultaneous detection is realized in the passageways on both sides of the cash blocks with a transmitting unit, cash blocks with switched-on and -off transmitters alternating with each other. When the passageways are consecutively numbered according to the series d1, d2, d3, d4, d5 etc., the detection is alternately switched on in the passageways d1, d2, d5, d6, d9, d10 etc. or in the passageways d3, d4, d7, d8, d11, d12 etc.

From the phase of the multiplex signal it is derived with suitable phase detection means in the receivers in which passageway detection takes place. With this information the signalling device belonging to the passageway is controlled. The detection in the passageways is therefore alternately switched on two by two.

This embodiment results in some electric losses caused by the parallel connection of two antennas via an impedance transformer which becomes evident in a decrease of detection sensitivity of 2 x 3 dB.

Multiplexing the transmitters themselves, like in a detached row of pillars, has the result that they are switched on only half the time. Consequently, the amount of label information per time unit is not maximal. This results in a slightly decreased reaction velocity or sensitivity. In practice, this effect is hardly noticeable.

These losses are avoided in the preferred embodiment shown in Fig. 4. Fig. 4 shows a schematic diagram. In this variant a preferably electronic switch member 14 or 15 is interposed between two antennas 6 and a transmitting unit 18 or receiving unit 17. The switch member behaves like a rapid relay with a change-over contact and may be realized , e.g., with PIN diodes or FET as a switch member. At low multiplex frequences an electromechanical relay is also possible. The switch member takes the place of the coupling transformer 13 which is used for parallel connection of two antennas.

Thus it is realized that alternately only those antennas are connected through which are actively used for detection. This avoids the losses caused by the parallel connected antenna which at that moment does not participate in the detection. Also, the transmitters are continuously switched on.

The performance of a system built up in this manner is comparable to that of a detached row of pillars in which multiplexing is effected by alternately switching on the even and odd transmitters. However, the number of electronics units has now been halved. In this variant multiplexing is effected between even and odd passageways to the left and right beside each cash desk and not between the passageways two by two as in the variant without antenna change-over switches. This is not essential to the operation of a system.

In principle, it is also possible to multiplex more than two-fold, e.g. 4-fold. This saves additional transmitters and receivers. In practice, however, this is at the expense of the reaction velocity and the sensitivity of the system. The requirements with respect to reaction velocity and sensitivity set a lower limit to the time a label signal of minimum strength must be present to enable reliable detection. Also, complicated cabling would be necessary.

Depending on the width of a passageway and the quality of the labels used, cost price and system performance may be balanced against each other.

It is observed that after the foregoing various modifications are obvious to those skilled in the art. Thus, the invention can also be applied without co-us-

ing shielded antennas. Moreover, the invention is applicable if in the space between two passageways no detection of responders is desirable or if the space between two passageways is blocked by a blocking element other than a cash block. For instance, on both sides of a constructional pillar there can also be mounted and energized two antennas of the same type as described in the foregoing.

Similarly, in the embodiment of Fig. 5 the receivers or the transmitters or both (as shown) can be controlled according to a multiplex system.

It is also possible to multiplex the receiving units. When, e.g., the system of Fig. 3 is used for two passageways, a transmitting unit like 18a can be used with on both sides an obstacle having a receiving unit. In that case the transmitting unit could be switched on continuously, while the receiving units are switched on and off alternately.

The shields 10 shown in the figures may comprise panels of metal gauze or other suitable shielding members.

These and similar modifications are considered to fall within the scope of the invention.

Claims

1. A shoplifting detection system, in particular suitable for use in shops designed as supermarkets, which detection system is designed to generate in a plurality of passageways separated from each other by obstacles a magnetic detection field by means of suitable transmitting antennas so as to enable by means of suitable receiving antennas detection of a responder located in the detection field and disturbing the detection field, transmitting and receiving units being provided which are connected with the transmitting and receiving antennas, characterized in that on both sides of each obstacle placed between two passageways antennas of the same type are provided, while the type of antenna of two juxtaposed obstacles separated by a passageway is always different.

2. A shoplifting detection system according to claim 1, characterized in that at least a plurality of obstacles comprises a cash block.

3. A shoplifting detection system according to claim 1 or 2, characterized in that at least one set of antennas of the same type belonging to one and the same obstacle is connected with an electronics unit common to said set of antennas and operating as a transmitting unit or receiving unit.

4. A shoplifting detection system according to claim 3, characterized in that a series of interspaced, juxtaposed obstacles is alternately provided with a common transmitting unit for the antennas belonging to the obstacle or a common receiving unit for the antennas belonging to the associated obstacle.

5. A shoplifting detection system according to claim 3 or 4, characterized in that the common electronics units are connected via a coupling uninterrupted in time with the associated antennas located on both sides of the associated obstacle.

6. A shoplifting detection system according to claim 5, characterized in that at least two successive transmitting units are connected with control means which by means of a multiplex signal alternately switch on and off successive transmitting units.

7. A shoplifting detection system according to any of claims 3-6, characterized in that at least two successive receiving units are connected with control means which by means of a multiplex signal alternately switch on and off successive receiving units.

8. A shoplifting detection system according to claim 3 or 4, characterized in that of the common electronics units at least the transmitting units or at least the receiving units or both the transmitting and the receiving units are connected via controllable change-over switches alternately in time with the antenna placed on one or the other side of the associated obstacle.

9. A shoplifting detection system according to claim 8, characterized in that juxtaposed transmitting and receiving units are alternately connected with the antennas placed opposite each other in a passageway between two obstacles or with the antennas placed on the sides of the obstacles facing away from each other.

10. A shoplifting detection system according to any of the preceding claims, characterized in that at least a plurality of antennas are provided with shielding means which electrically shield the antennas from the obstacles beside which the antennas are placed.

11. A shoplifting detection system according to claim 10, characterized in that the shielding means comprise panels of metal gauze.

12. A shop design, characterized by a shoplifting detection system according to any of the preceding claims.

13. A cash block for use in a shop design acording to claim 12, characterized by a single electronics unit designed as a transmitting or receiving unit, and which is connected with two antennas provided on both sides of the cash block.

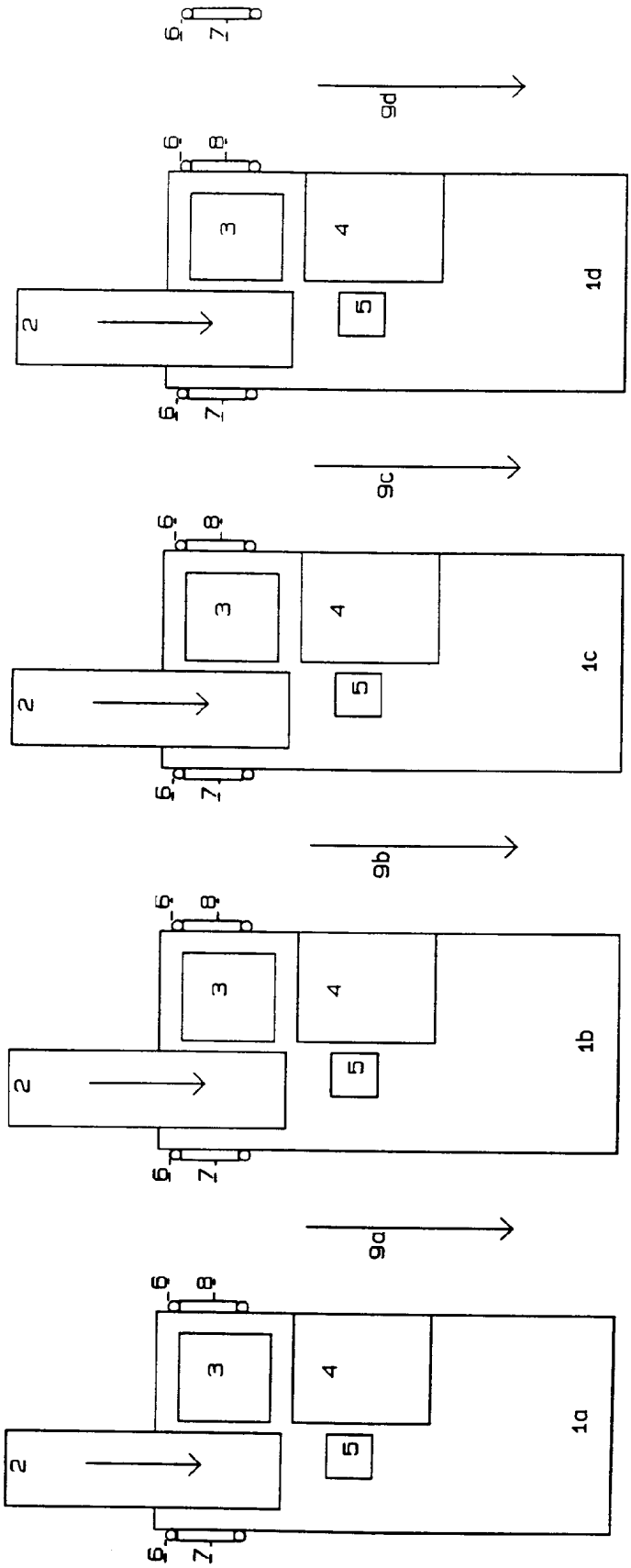

FIG.1

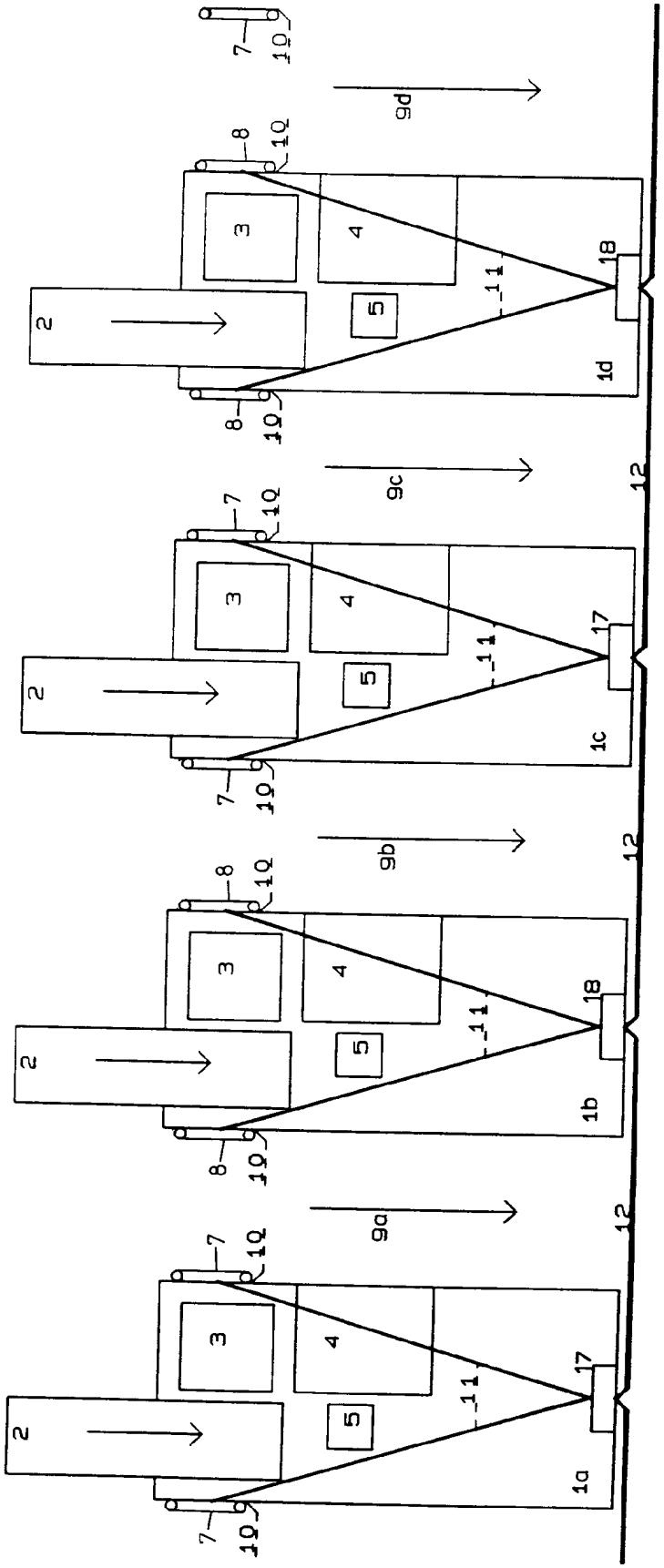

FIG.2

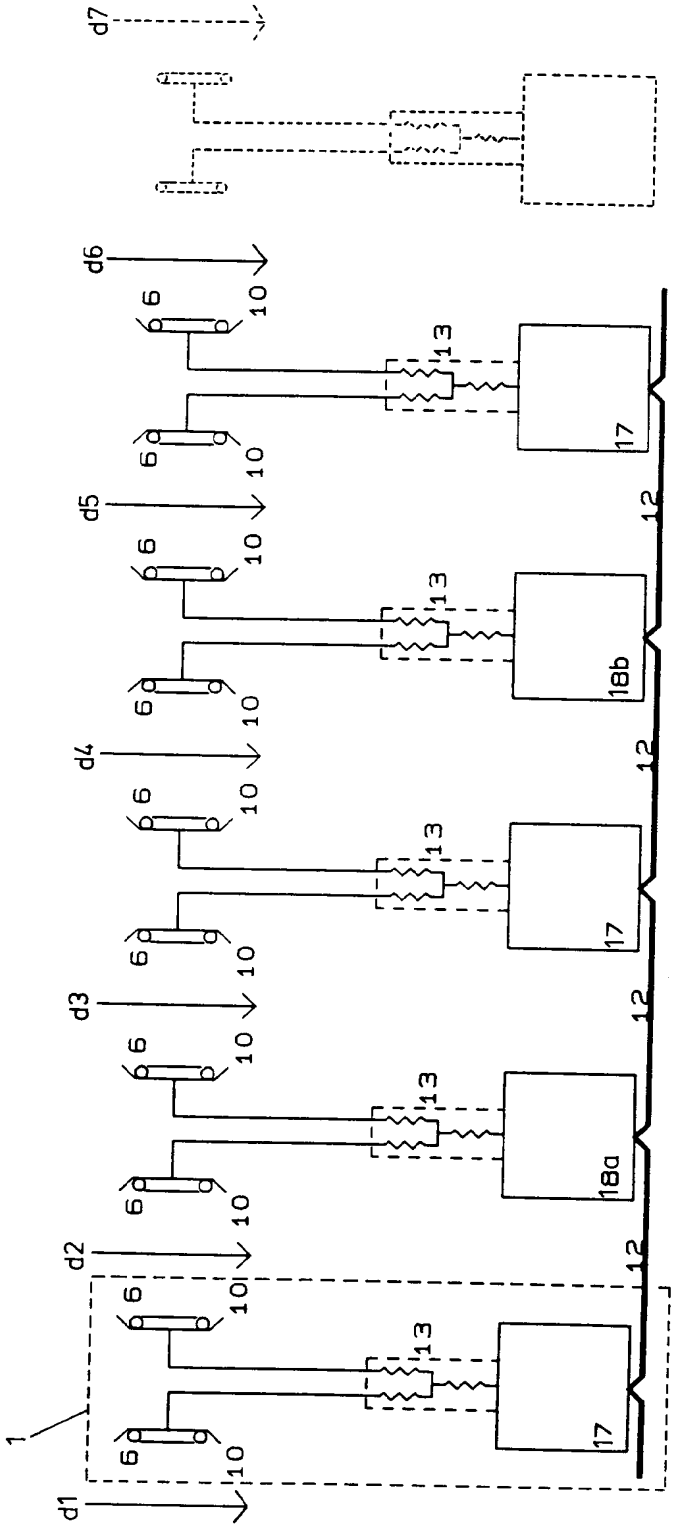

FIG.3

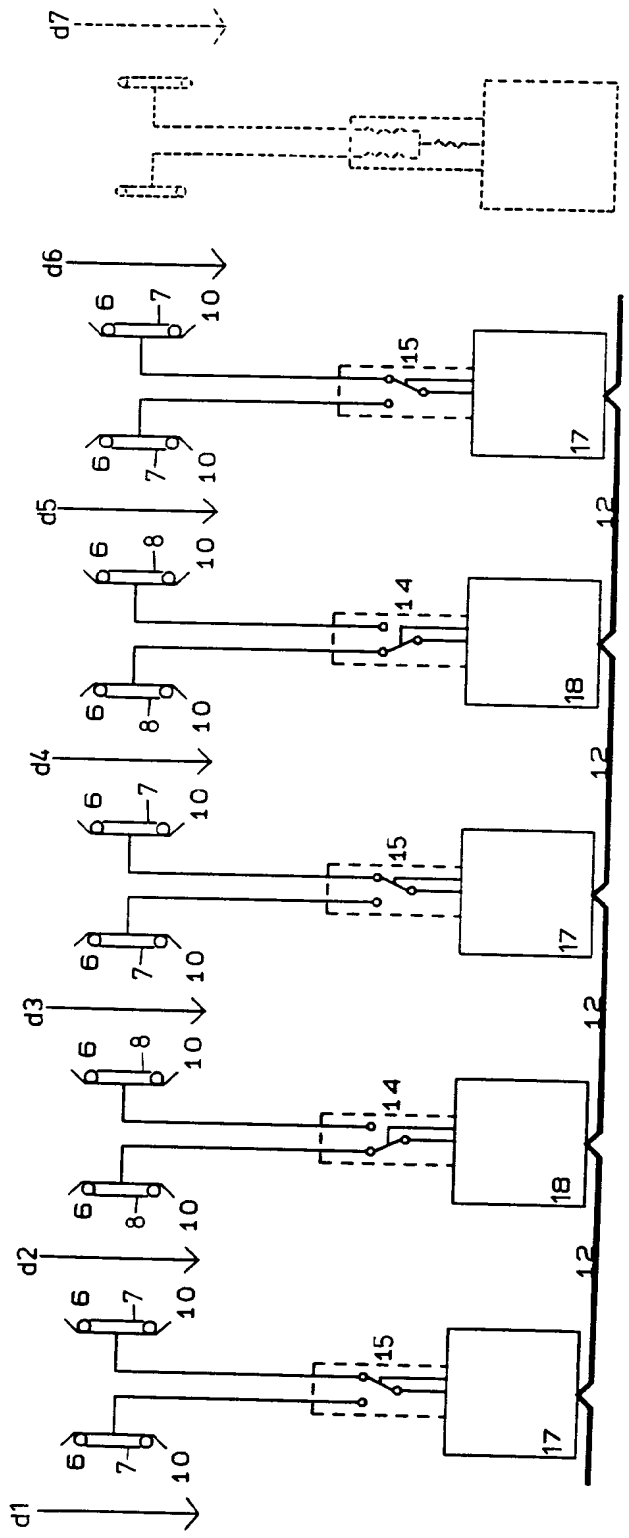

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0142

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	EP-A-0 035 660 (KNOGO CORP.) * page 2, line 25 - page 8, line 21; figure 1 *	1-12	G08B13/24
A	WO-A-91 17533 (NEDAP) * abstract *	1,10,11	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 April 1994	Sgura, S

CATEGORY OF CITED DOCUMENTS

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